Motorola HOME Radio

CHASSIS HS-38
HS-39

SERVICE MANUAL

1946 MODELS 95F31, 95F31B, 95F31M AND 95F33

GENERAL INFORMATION

TYPE - 9 tube combination FM-AM phonograph-radio with separate loop antennas for AM and FM channels.

95F31 - (Golden Voice) Console type "walnut" cabinet, using HS-39 chassis.
95F31B - (Golden Voice) Console type "blonde" cabinet, using HS-39 chassis.
95F31M - (Golden Voice) Console type "mahogany" cabinet, using HS-39 chassis.
95F33 - Upright type "walnut" cabinet, using HS-38 chassis.

TUBE COMPLEMENT: 7F8 FM Converter, 7Q7 BC & SW Converter, 6SG7-4.3 Mc & 455 Kc IF Amplifier, 6SG7 -4.3 Mc IF Amplifier, 6S8GT FM Ratio Detector-AM Detector-AVC & 1st AF Amplifier, 6SQ7 Phase Inverter, (2) 6K6GT Push-Pull Power Output and 5Y3GT Rectifier.

POWER SUPPLY - 117 volts AC, 60 cycles; 110 watts; 130 watts with record changer.

TUNING RANGE - BC 535 - 1620 Kc
SW 5.8 - 12.2 Mc
FM 88 - 108 Mc

RECORD CHANGER - B-27-RC or B-29-RC (for complete Record Changer information refer to Motorola Service Manual, Part No. 54P75094).

PUSH BUTTON TUNER - Model E-33-T AM-FM Electric Tuner

SUMMARY OF OPERATING AND INSTALLATION INSTRUCTIONS

ANTENNAS

No outside antenna or ground is required. A short wave antenna is provided in cabinet. The "Aero-Vane" loop antenna for broadcast and short wave reception is located at the rear of the cabinet and should be rotated for maximum volume of a weak station when the radio is installed. In locations where additional pick-up on broadcast and short wave is desired, an external antenna may be connected to clip marked AM EXTERNAL ANTENNA.

The FM antenna is a stationary figure 8 shaped loop. Additional FM pick-up for receivers being operated in "fringe" or "weak" FM signal areas can be secured by connecting an external dipole antenna to the clips marked FM external antenna.

IMPROVING FM RECEPTION IN WEAK SIGNAL AREAS

The nature of the very high frequencies used in the transmission and reception of FM signals is such that the signals are propagated along "line of sight" paths. In other words, these signals behave like light waves; that is, they follow straight paths, are blocked from reaching the receiving antenna by intervening objects such as tall buildings, hills, etc., or if the distance between transmitter and receiver is great, "line of sight" between transmitter and receiver is impossible due to the curvature of the earth. Like light waves, these signals can also be reflected; in the case of FM signals, buildings and hills can and do act as reflectors. See Figure 1.

From the above you can see that there are

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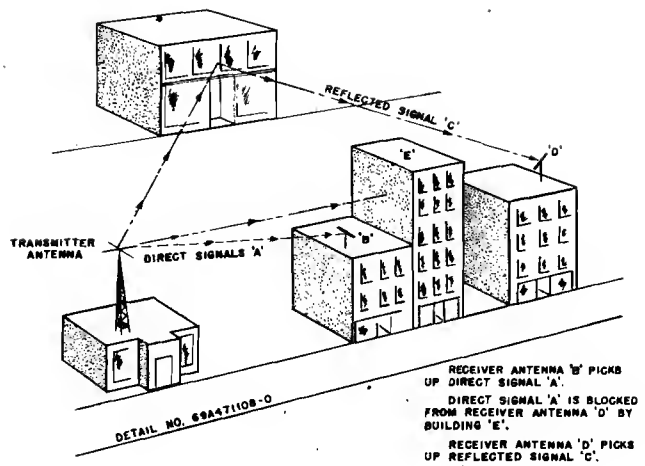


FIGURE 1. DIRECT AND REFLECTED FM RECEPTION PATHS

many factors that can affect FM reception. Normally, reliable and noise-free FM reception can be had only if "line of sight" exists between transmitter and receiver antennas, unless the signal is reflected around interfering objects.

This Motorola FM receiver is equipped with a stationary figure 8 loop antenna. This loop antenna will give perfect pickup in normal FM service areas such as are found in and for a few miles around metropolitan areas being served by FM stations.

In "fringe" or "weak" FM signal areas, improved reception can be obtained by using a dipole antenna, mounted as high as possible. The higher the antenna, the less noise pickup.

The orientation of the dipole antenna has a definite effect on reception. In normal unobstructed areas for single station reception, the broadside of the antenna is pointed toward the transmitting antenna of the station. In many localities, reflections are present and the antenna broadside should be aimed in the direction of greatest response or in such a direction as to give maximum response for all stations in your area, if there are more than one.

Each individual home installation should be treated in its own light. Due to the very nature of some locations, it may be found that a single antenna will provide good reception for some stations and poor reception for others. In such a case, it is almost a necessity to have the customer choose the stations desired and then to orient the antenna for maximum response of these stations. In other cases, a happy medium arrived at by choice of antenna, its location and direction, may be reached which will give acceptable overall response for all stations available.

Motorola receivers using a figure 8 FM loop, have provisions to match dipole antennas with 300 ohms impedance. But, since it has been found that all dipoles do not present this impedance, it may be necessary to match the set to the antenna.

This may be done by repositioning the external antenna taps on the FM loop. If your receiver has these taps soldered on the right of the loop (looking at it from the rear), remove these taps. See Figure 2.

To arrive at a correct match, take a twisted pair of wires, attach one end to the FM EXTERNAL ANTENNA fahnestock clips, on rear of cabinet, add minature battery clips to the other end, and locate the proper positions by sliding the clips around the loop. A correct match will, of course, be indicated by a volume step up of a weak station. You will find that in many instances, the improvement is amazing. After the correct impedance match is found, remove the clips and securely solder the twisted pair to the loop.

If your receiver already has adjustable loop taps, it will not be necessary to do any soldering or unsoldering, simply slide the taps around until correct impedance match is obtained as indicated above.

Any well constructed commercially made dipole antenna, designed to be used in the 88-108 megacycle FM band, can be used. The lead-in should be a 300 ohm twin-lead transmission line.

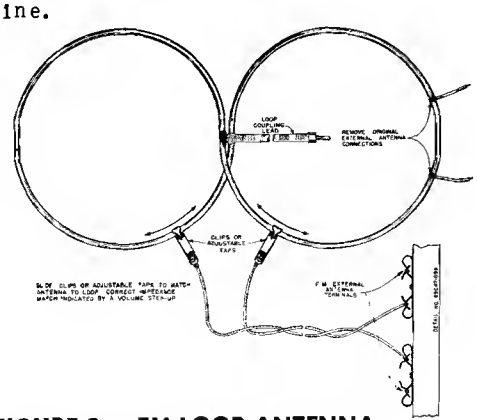


FIGURE 2. FM LOOP ANTENNA

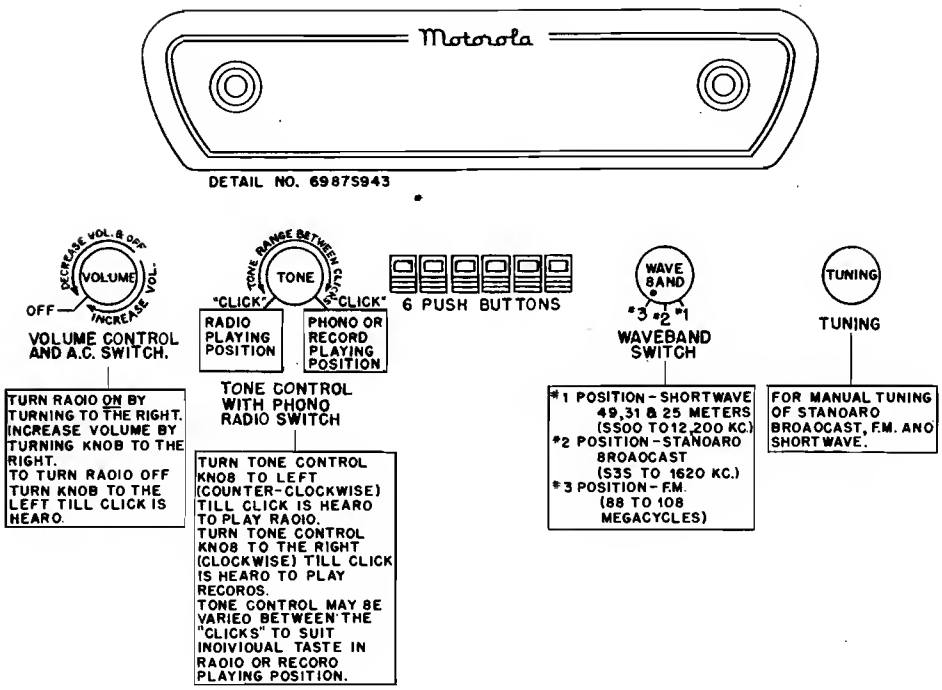


FIGURE 3. CONTROLS

CONTROLS

Refer to Figure 3 for instructions pertaining to use of the controls located on the receiver front panel.

The standard broadcast dial scale is read in kilocycles by adding one "0" to figure. The FM band dial scale is read either in channels (200 to 300) or megacycles (88 to 108). The short wave dial scale is read directly in megacycles.

NOTE: When tuning, tune carefully until you are exactly ON the station. Tuning to either side of it will result in poor tone quality and excessive noise. Tuning of FM stations should be done very slowly and carefully, as 3 peaks are present; the center peak is the correct one; distortion and low volume are characteristic of the other two peaks.

INSTRUCTIONS FOR SETTING AUTOMATIC TUNER PUSH BUTTONS

1. Turn the radio ON and allow it to warm up for a period of at least fifteen minutes.
2. While waiting for the radio to warm up, loosen the tuner locking screw (A) all the way. The locking screw is accessible from the rear of the cabinet. (See Figure 4).
3. Make a list of the frequencies of the local stations you wish to tune in automatically. It is recommended that you select the most powerful stations only.
4. Turn the band switch to FM or BC position, depending on the station being setup, and carefully tune in the first station.

   NOTE: The buttons may be used on either BC, FM, or any combination of AM and FM. BE SURE TO SET THE BAND SWITCH ON THE PROPER BAND!
5. Adjust a signal generator to zero beat with the AM station.

   NOTE: While it is advisable to use a signal generator for accuracy, it is not an absolute necessity. The station signal may be used.
6. Tune to the desired station or to the signal generator, with the tuning knob (right hand control).
7. Holding the tuning knob, push the selected button and HOLD IN UNTIL THE MOTOR STOPS.
8. Repeat steps 6 and 7 for each of the buttons.

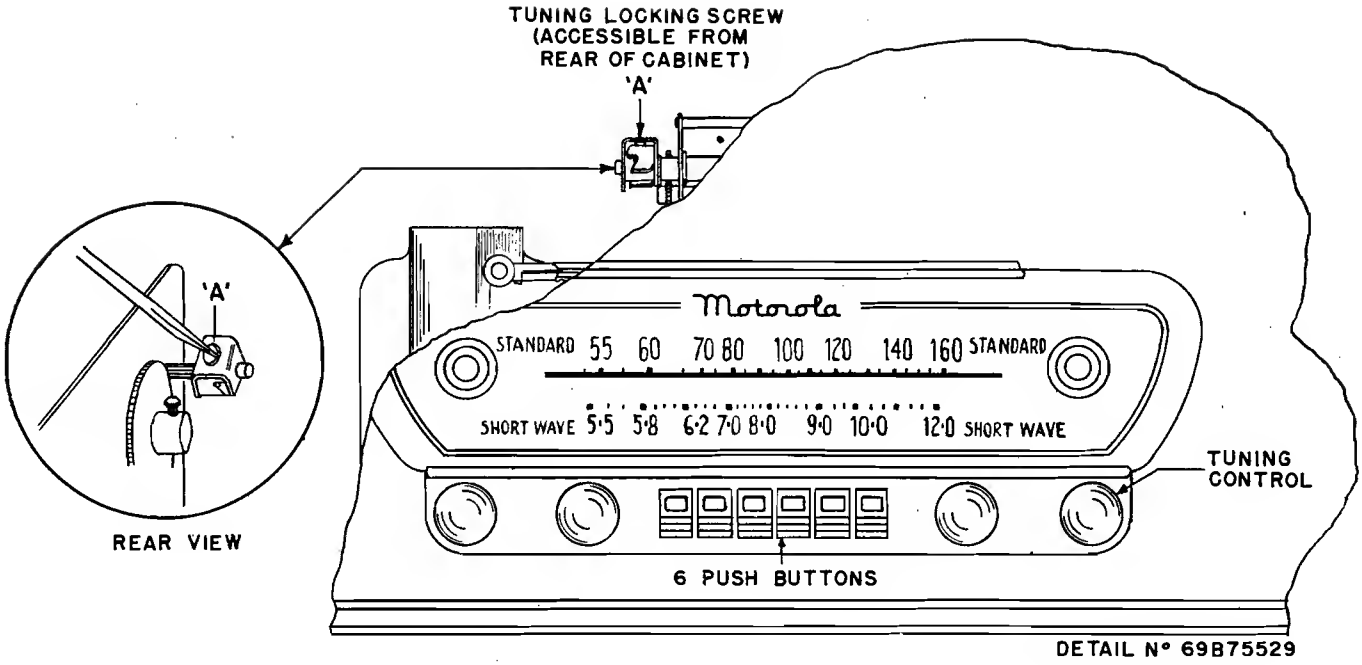


FIGURE 4. TUNER LOCKING SCREW LOCATION

9. Carefully tighten the tuner locking screw (A).

10. Check the setting of the button by tuning in the station manually, then push the button set for that station; no effect on volume or tone should be noticed. If not correctly set, readjust--following steps 4 through 9.

RECORD CHANGER OPERATION

WHAT RECORDS CAN BE PLAYED

As many as 10 ten-inch or 8 twelve-inch records may be placed on the record changer which will play them all in sequence, repeating the last record until the instrument is turned "OFF". Do not overload the instrument by attempting to stack more records on it at one time.

This record changer will accommodate most 10 and 12 inch records now available on the market, but is not guaranteed to handle all of them. Records must be in good condition as no record changer will operate properly with chipped or warped records. Records in which the center hole is worn or chipped should be discarded.

Occasionally, a new record may fit tightly over the center spindle due to the label attached to the record not being properly centered. This condition may be readily remedied by reaming out the center hole with a hexagonal lead pencil.

When operating this automatic record changer, play only the size record for which the adjustment on the record support platform indicates. Do not inter-mix 10 and 12 inch records.

TO LOAD RECORDS

1. Adjust the Record Support
   The tuning of the record support automatically adjusts the changer for either ten or twelve inch records. For playing ten-inch records the numeral (10) will be nearest the record spindle. (See Figure 5).

2. Adjust the Record Hold-Down Plate
   This plate or flipper is mounted on the record support, (See Figure 5), and serves to steady the stack of records. Flip it away from the turntable.

3. Load the Records
   Place the records over the record spindle, so they rest on the record support and on the small ledge formed by the offset in the spindle. Records may be loaded and played one at a time, or as many as 10 ten-inch or 8 twelve-inch records may be loaded at one time. Do not try to play a larger quantity.

4. Readjust the Record Hold-Down Plate
   Flip the record hold-down plate back over the record support so it rests on the rim of the top record and holds the stack of records steady.

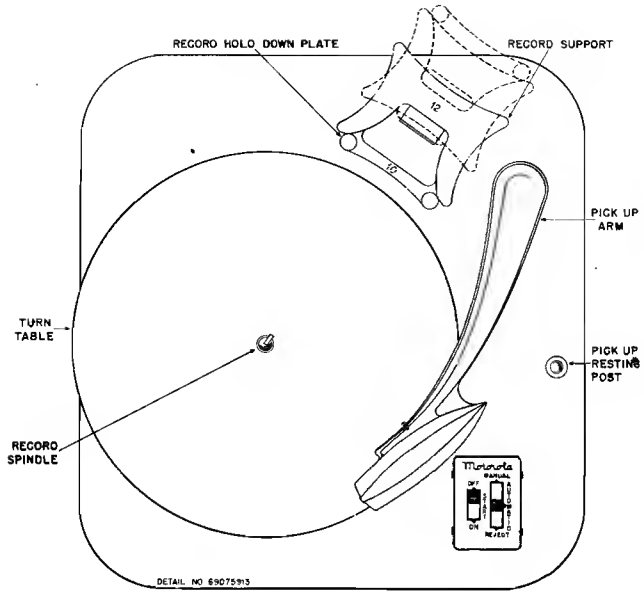


FIGURE 5. RECORD CHANGER TOP VIEW

TO PLAY RECORDS AUTOMATICALLY

1. Turn VOLUME control "ON". Allow 20 to 30 seconds for tubes to warm up. Turn the PHONO-RADIO selector control to PHONO position. (See Figure 3).

2. Push the left hand button in the lower right hand corner in the direction indicated by the START arrow to the ON position. (See Figure 5).

Push the right hand button to the REJECT position. The button will return to the AUTOMATIC position when released and the bottom record on the stack will drop to the turntable and play. After all records have been played in turn, the instrument will repeat the last record until it is turned "OFF". The right hand button may also be pushed to reject a record before it has been completely played.

NOTE: When the right hand button is pushed to the "START" or "REJECT" position and released, it will return to the center or "AUTOMATIC" position. This is the position for use when it is desired to play records automatically.

CAUTION

When playing records automatically, never touch the pick-up arm when the instrument is in a changing cycle. Should you accidentally move it out of adjustment, the self-centering device will automatically return the arm to the proper position.

To avoid warping of records, remove them from the changer as soon as they have been played and store them so they rest either vertically or horizontally. Good records deserve the protection of record albums.

Records should never be exposed to heat from the sun, high-powered electric lights or radiators.

TO PLAY RECORDS MANUALLY

1. Turn the VOLUME control on. Allow 20 to 30 seconds for the tubes to warm up. Turn the PHONO-RADIO selector control to PHONO position. (See Figure 3).

2. Push the right hand button to the "MANUAL" position. (See Figure 5).

3. Turn the record support so that the numeral 12 will be nearest the spindle and flip the record hold-down plate away from the turntable. (This allows more room for loading and unloading of records).

4. Place a record on the turntable.

5. Push the left hand switch to the "ON" position. The turntable will now revolve.

6. Lift the pick-up arm from its resting post and place in starting groove on record.

7. After record has been played, lift pick-up arm off record and place on pick-up resting post.

TO UNLOAD RECORDS

1. Allow the instrument to go through its complete cycle and start to play the last record over.

2. As soon as this occurs, push the left hand switch button to the "OFF" position.

3. Lift the pick-up arm from the record and place on its resting post.

4. Lift the records off.

HOW TO REPLACE NEEDLE

This changer is equipped with a permanent point (Sapphire or precious metal) long life needle and is good for several thousand plays unless damaged by dropping or other mishandling.

For best results, use Motorola Phonograph Needles. They have been especially designed for use in this changer.

To replace phonograph needle, loosen the small set screw that holds the needle in place. The needle set screw is accessible through a small hole located on the front of the pick-up arm. Use a small screwdriver to avoid damaging the pick-up arm or crystal cartridge.

TO TURN OFF THE RECORD CHANGER AND RECEIVER

The switch on the volume control is the master switch which turns off the record changer and receiver. The ON-OFF on the record changer should be placed in the OFF position, otherwise the record changer will revolve when the receiver is turned on.

FM SERVICE NOTES

In some cases, people are not tuning FM sets properly. FM is more difficult to tune than AM, although Motorola receivers are easier than most. There are three peaks present; the center peak, which is the correct one, is hard to locate. The peaks on either side of the center are slightly distorted. If you get a distorted peak on only <u>one</u> side of the center, the discriminator is probably out of alignment.

Some people expect too much of FM. You cannot expect great distance. The horizon, as viewed from the transmitting antenna, is the normal service area. Many FM stations are now operating on the low power, waiting for new equipment. Reception will improve greatly when power is increased. Most of the bad reports have come from the fringe areas. In many cases reception can be improved by using a dipole antenna, mounted as high above the roof as possible, and aimed directly at the station.

Location of the radio is important when it is operated on its built-in loop antenna. Moving the set even a few feet away from its present location may increase or reduce signal strength by more than 50% because a stronger signal may exist at one location than another. Therefore, in homes where reception is poor, you may be able to improve it by placing the set against another wall. The Motorola figure 8 loop antenna is omnidirectional.

Motorola FM sets use a relatively new circuit known as the Ratio Detector, instead of the usual limiters. The following paragraph of explanation is quoted from the R.C.A. License Laboratory Bulletin:

> "Since a circuit of this type is relatively immune to amplitude modulation, it is unnecessary to precede it by a limiter stage. Also, since its immunity is not a direct function of the signal strength, there is no threshold action of the type encountered where limiters are employed."

It has been thought, erroneously, that the use of limiters in an FM receiver is <u>imperative</u> for proper reception. This is not the case. In this connection, it is important to understand that a limiter requires several volts at its grid to become effective. If the received signal strength is too weak to provide the required voltage at the limiter grid, <u>the limiters do not function.</u> This means that below a certain threshold of signal level, the limiters do not work and as a result do not contribute to amplitude (noise) rejection. Furthermore, noise voltages are not purely amplitude modulated, but contain frequency modulated components against which no amplitude rejection device will discriminate.

From the above comparison, you can see that there is little, if any, difference between the two circuits insofar as noise reception is concerned. In either case, low signal levels from the FM stations will result in noise reception, if there is any noise in the neighborhood.

The main advantages of ratio detection, as used in Motorola FM are, first, very little between station noise, and second, easier tuning because the side peaks are slightly subdued (as compared to the limiter type of receiver), making it easier to find the center peak.

ALIGNMENT

ALIGNMENT PROCEDURE WHEN USING AM MODULATED SIGNAL GENERATOR AND STANDARD OUTPUT METER FOR COMPLETE RECEIVER ALIGNMENT.

An AM (amplitude modulated) signal generator covering the frequencies shown in alignment chart, is used to align the broadcast, short wave and FM bands. A low range output meter, connected across the speaker voice coil is used as an output indicator.

The broadcast and short wave alignment is conventional; full instructions are given in the following alignment chart.

The FM band alignment can be satisfactorily performed by following the instructions in the chart. When properly aligned, the discriminator does not respond to amplitude modulation and since an AM type signal generator is used for aligning the FM circuits, it is necessary to detune the discriminator secondary and leave it that way until all of the FM circuits have been aligned. After completing the alignment of the FM circuits, proceed to align the discriminator secondary by applying a 4.3 MC AM signal to the control grid of the 7F8 2nd FM converter tube and adjusting the discriminator secondary core for minimum audio output. No adjustment of the FM circuits should be attempted with AM after the discriminator secondary has been properly aligned.

Use a 30% AM (amplitude modulated) signal throughout entire alignment procedure.

A dial scale should be temporarily mounted or held in position on Chassis HS-38 to facilitate calibration.

Use an insulated screwdriver when adjusting the FM tuner trimmers.

A special wrench for adjusting the slotted nuts on the tuner cores will be required. You can easily fabricate one from a Motorola auto set Volume Control Shaft and Coupling Assembly (Part No. 1B70847, $.30 list) by simply spreading out the forked ends and filing to fit. Solder the assembly together to make it rigid.

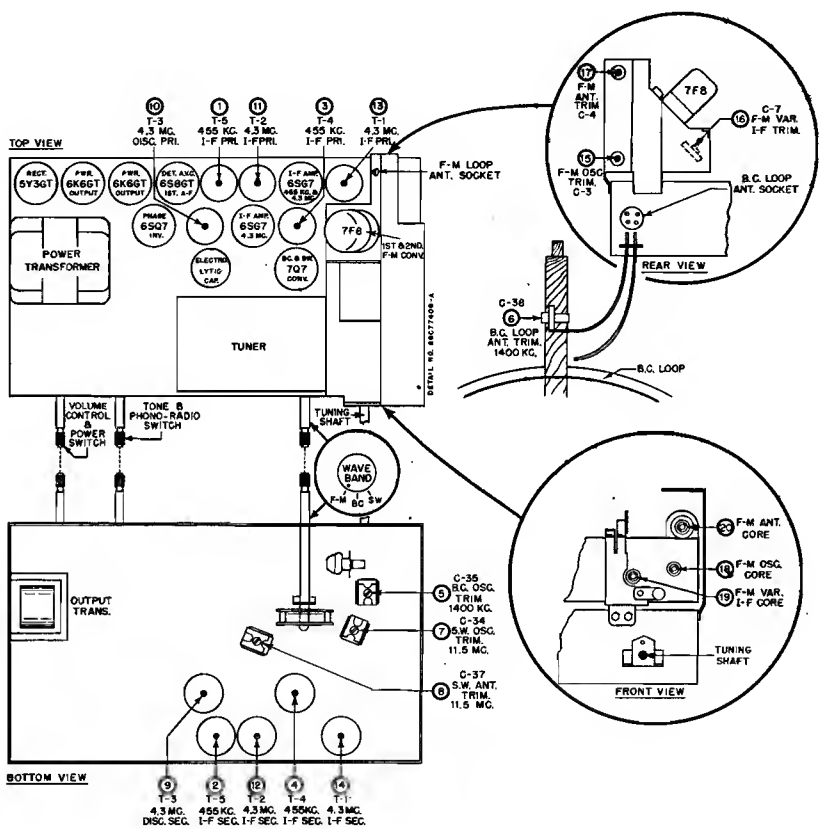


FIGURE 6. TUBE AND TRIMMER LOCATIONS

CHART I. ALIGNMENT PROCEDURE WHEN USING AM MODULATED SIGNAL GENERATOR AND STANDARD OUTPUT METER FOR COMPLETE RECEIVER ALIGNMENT.

STEP	DIAL SET TO	BAND SW. SET TO	DUMMY	SIGNAL GENERATOR CONNECTED TO	SIGNAL GENERATOR SET AT	ADJUST TRIMMER OR CORE	REMARKS
455 Kc I.F. CHANNEL ALIGNMENT							
1.	1620 KC	B.C.	.1 MF.	7Q7 B.C. & S.W. CONV. GRID (PIN #4) & CHASSIS	455 KC	1, 2, 3 & 4	ADJUST FOR MAXIMUM OUTPUT
BROADCAST BAND ALIGNMENT							
2.	1400 KC	B.C.	.1 MF.	7Q7 B.C. & S.W. CONV. GRID (PIN #4) & CHASSIS	1400 KC	5(B.C. OSC. TRIM)	SET OSCILLATOR TO DIAL. (ON CHASSIS HS-38, MOUNT OR HOLD DIAL SCALE TEMPORARILY ON CHASSIS WITH GANG FULLY MESHED, POINTER SHOULD BE AT LAST MARK ON DIAL. THEN SET TO 1400 KC. AND SET OSCILLATOR.)
3.	1400 KC	B.C.	NONE	RADIATION LOOP.*	1400 KC	6(B.C. LOOP ANTENNA TRIM.)	ADJUST FOR MAXIMUM OUTPUT
SW. BAND ALIGNMENT							
4.	11.5 MC	S.W.	.1 MF	7Q7 B.C. & S.W. CONV. GRID (PIN #4) & CHASSIS	11.5 MC	7(S.W. OSC. TRIM)	SET OSC. TO DIAL. MAKE SURE OSC. IS HIGHER IN FREQUENCY THAN THE SIGNAL BY CHECKING IMAGE RESPONSE WHICH SHOULD OCCUR WITH THE INPUT SIGNAL AT 12.41 MC.
5.	11.5 MC	S.W.	50 MMF	S.W. ANT. TERMINAL AND CHASSIS.	11.5 MC	8(S.W. ANT. COIL TRIM)	B.C. LOOP PLUG SHOULD BE DISCONNECTED. ADJ. FOR MAXIMUM OUTPUT
4.3 Mc I.F. CHANNEL ALIGNMENT							
6.						9(DISC. SEC.)	DETUNE DISCRIMINATOR SECONDARY BY SCREWING CORE OUT AS FAR AS IT WILL GO.

STEP	DIAL SET TO	BAND SW. SET TO	DUMMY	SIGNAL GENERATOR CONNECTED TO	SIGNAL GENERATOR SET AT	ADJUST TRIMMER OR CORE	REMARKS
7.	112 MC	FM	.001 MF	7F8 2ND FM CONVERTOR GRID (#1 PIN) & CHASSIS	4.3 MC	10, 11, 12, 13 & 14 (4.3 MC I.F.)	ADJUST FOR MAXIMUM OUTPUT
FM BAND ALIGNMENT							
8.						18 (FM OSC. CORE)	CHECK THE POSITION OF THE FM OSC. TUNING CORE 18. SET SPACING BETWEEN THE CORE AND BAKELITE PIECE TO WHICH IT IS MOUNTED, TO 1/32" BY TURNING TUNING CORE SLOTTED NUT.
9.	90 MC	FM	NONE	FM LOOP ANTENNA RECEPTACLE & CHASSIS REMOVE FM LOOP.	90 MC	15, 16 & 17 (FM OSC., ANT. & VARIABLE I.F. TRIM)	ADJUST FOR MAXIMUM OUTPUT
10.	105 MC	FM	NONE	FM LOOP ANTENNA RECEPTACLE & CHASSIS REMOVE FM LOOP.	105 MC	18, 19 & 20 (FM OSC., ANT. & VARIABLE I.F. CORES)	ADJUST FOR MAXIMUM OUTPUT
11.							REPEAT STEPS 9 AND 10 SEVERAL TIMES UNTIL FURTHER ADJUSTMENT DOES NOT INCREASE THE OUTPUT. MAKE THE FINAL TRIMMER ADJUSTMENT AT 105 MC. (I.E., TRIMMERS 15, 16 AND 17 AT 105 MC).
12.	105 MC	FM	NONE	RADIATION LOOP *	105 MC	17 (FM ANT. TRIMMER)	ADJUST FOR MAXIMUM OUTPUT WITH FM LOOP ANTENNA CONNECTED.
ALIGN DISCRIMINATOR SECONDARY							
13.		FM	.001 MF	7F8 2ND FM CONVERTOR GRID (#1 PIN) & CHASSIS	4.3 MC	9(DISC. SEC.)	ADJUST DISCRIMINATOR SECONDARY FOR MINIMUM RESPONSE. THE CORRECT ADJUSTMENT IS THE SHARPLY DEFINED MINIMUM RESPONSE POINT BETWEEN THE TWO PEAKS.

* CONNECT OUTPUT OF SIGNAL GENERATOR TO A 5" DIAMETER, 3 TURN LOOP & RADIATE SIGNAL INTO RECEIVER LOOP. MINIMUM DISTANCE BETWEEN LOOPS SHOULD NEVER BE LESS THAN 12".

CHART II. ALIGNMENT PROCEDURE WHEN USING FM SIGNAL GENERATOR AND OSCILLOSCOPE.

STEP **OPERATION**

455 Kc. I.F. Channel Alignment

1. Same as step 1 in Chart I (Use AM signal generator)

Broadcast Band Alignment

2. Same as steps 2 & 3 in Chart I (Use AM signal generator)

S. W. Band Alignment

3. Same as steps 4 & 5 in Chart I (Use AM signal generator)

4.3 Mc I.F. Channel Alignment Using FM Signal Generator & Oscilloscope

4. (A) Discriminator -

   1. Connect the input terminals of the oscilloscope vertical amplifier to the high side of the receiver volume control and the chassis.

   2. Connect the FM generator synchronizing voltage output terminals to a phase shifting network, consisting of a variable 1/2 megohm resistor in series with a .002 mf capacitor. The input to the oscilloscope horizontal amplifier is connected across the .002 mf capacitor. See Figure 7. (This phase shifting network may not work with every oscilloscope. Different values of R & C may be required).

   3. Apply an FM 4.3 Mc Signal (125 Kc deviation) through a .01 mf capacitor to the control grid (pin #4) of the 6SG7 tube in the second I.F. amplifier stage.

   4. Screw discriminator secondary core (9) out as far as it will go.

   5. Adjust discriminator primary until the pattern obtained on the scope is symmetrical about the vertical axis. The phase shifting network resistor is adjusted to give only one trace. The pattern obtained is the resonance curve of the primary, whose maximum response should be at exactly 4.3 Mc. (See Figure 8).

   6. Adjust discriminator secondary until a symmetrical pattern is obtained, with peaks occurring at about 100 Kc above and below 4.3 Mc and is substantially linear between peaks. The trace should pass through the intersection of the vertical and horizontal axis. The phase shifting network should be adjusted to give only a single pattern at all times. (See Figure 9).

   (B) 4.3 Mc I.F. Amplifiers -

   1. Apply an FM 4.3 signal (100 Kc deviation) to the control grid (pin #4) of the 6SG7 tube in the 1st I.F. amplifier stage, through a .001 mf capacitor and adjust both primary and secondary cores (11 & 12) to get a symmetrical pattern as before, with peaks occurring at a slightly lower deviation.

   2. Apply an FM 4.3 Mc signal (100 Kc deviation) to the control grid (pin #1) of the 7F8 tube, and adjust both primary and secondary cores (13 & 14) until a symmetrical pattern substantially linear between peaks, is obtained.

FM Band Alignment

5. Check the position of the FM oscillator tuning core (18). Set the spacing between the core and the bakelite piece to which it is mounted, to 1/32" by turning tuning core slotted nut.

STEP	OPERATION

6. Remove the FM loop and connect generator output directly to the receiver FM loop receptacle.

7. Set receiver dial to 90 Mc and also FM signal generator to 90 Mc. (22-1/2 Kc deviation). Adjust FM oscillator, antenna & variable I.F. trimmers (15, 16 & 17) for maximum indication on output meter. (Output meter should be connected across speaker voice coil).

8. Set receiver dial to 105 Mc and also FM signal generator to 105 Mc (22-1/2 Kc deviation). Adjust FM oscillator, antenna and variable I.F. Cores (18, 19 & 20) for maximum indication on output meter.

9. Repeat steps 7 & 8 several times until further adjustment does not increase the output. Make the final trimmer adjustment at 105 Mc. (i.e. trimmers 15, 16 and 17 at 105 Mc.).

10. Connect FM loop antenna to receiver receptacle. Radiate an FM 105 Mc (22-1/2 Kc deviation) signal into FM loop. Set receiver dial to 105 Mc and adjust trimmer (17) for maximum.

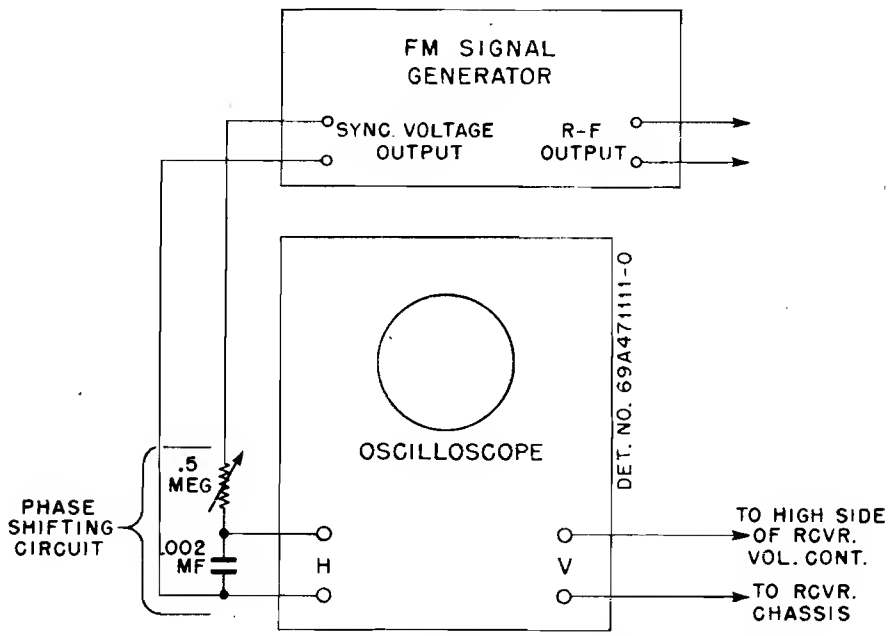
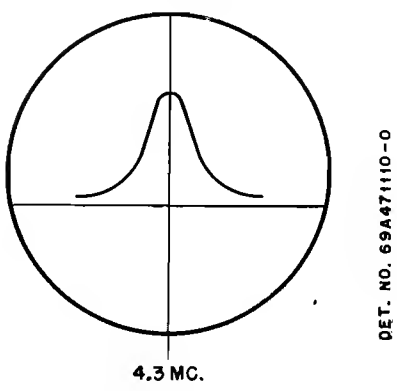
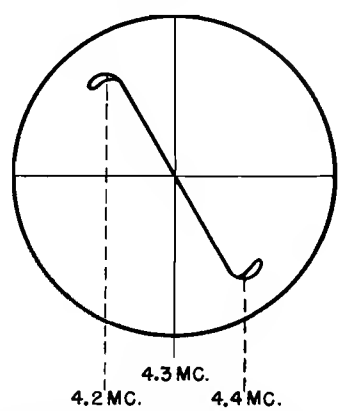


FIGURE 7. SIGNAL GENERATOR & OSCILLOSCOPE HOOK-UP



PATTERN WITH DISCRIMINATOR PRIMARY (10) CORRECTLY ADJUSTED.

FIGURE 8.



PATTERN WITH DISCRIMINATOR SECONDARY (9) CORRECTLY ADJUSTED.

FIGURE 9.

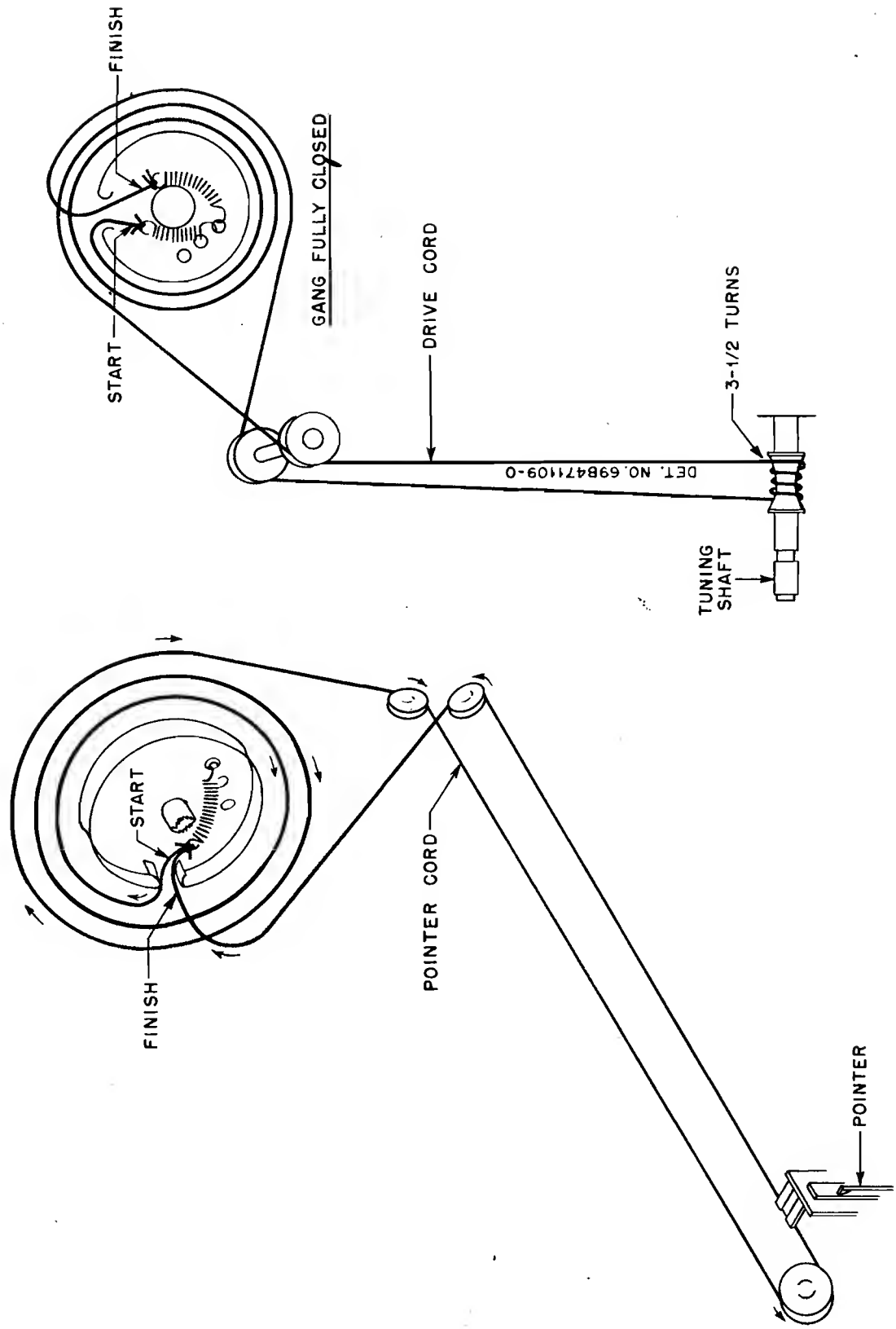
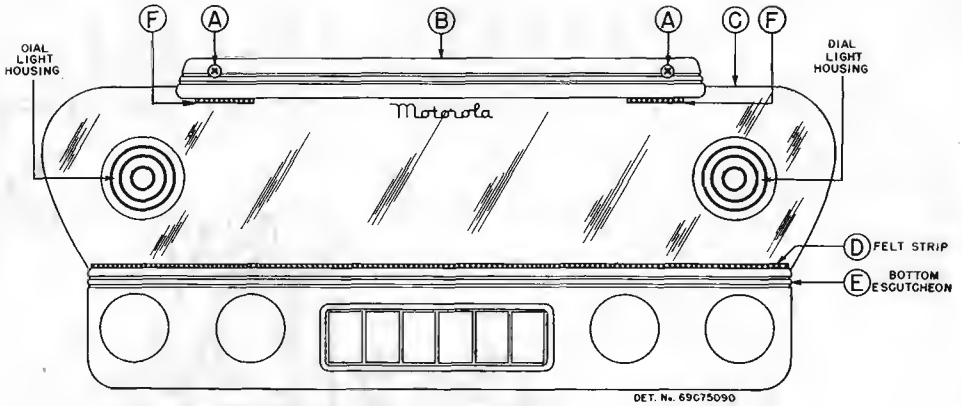


FIGURE 10. POINTER AND DRIVE CORD DETAIL



TO SERVICE LONG LIFE PILOT LIGHTS, PROCEED AS FOLLOWS:

1- UNSCREW THE TWO SCREWS MARKED 'A' AND REMOVE BAKELITE ESCUTCHEON 'B'.

2- PULL TOP OF GLASS DIAL SCALE 'C' FORWARD UNTIL DIAL LIGHT HOUSINGS CLEAR CABINET, THEN LIFT GLASS DIAL SCALE CLEAR OF CABINET.

3- REPLACE DEFECTIVE PILOT LIGHT. USE #51 BULBS ONLY.

4- BEFORE REPLACING DIAL SCALE, REMOVE FELT STRIP 'D' FROM BOTTOM ESCUTCHEON 'E'. FLATTEN FELT AND LAY OVER GROOVE IN ESCUTCHEON 'E'.

5- REPLACE DIAL SCALE BY LAYING LOWER EDGE ON FELT IN BOTTOM ESCUTCHEON 'E' AND PRESSING DIAL SCALE DOWN UNTIL PILOT LIGHT HOUSINGS SNAP INTO PLACE.

6- REPLACE UPPER ESCUTCHEON 'B'. MAKE CERTAIN THE TWO FELT STRIPS 'F' ARE PROPERLY PLACED BEFORE FASTENING ESCUTCHEON.

FIGURE 11. DIAL LIGHT REPLACEMENT DETAIL (95F33 ONLY)

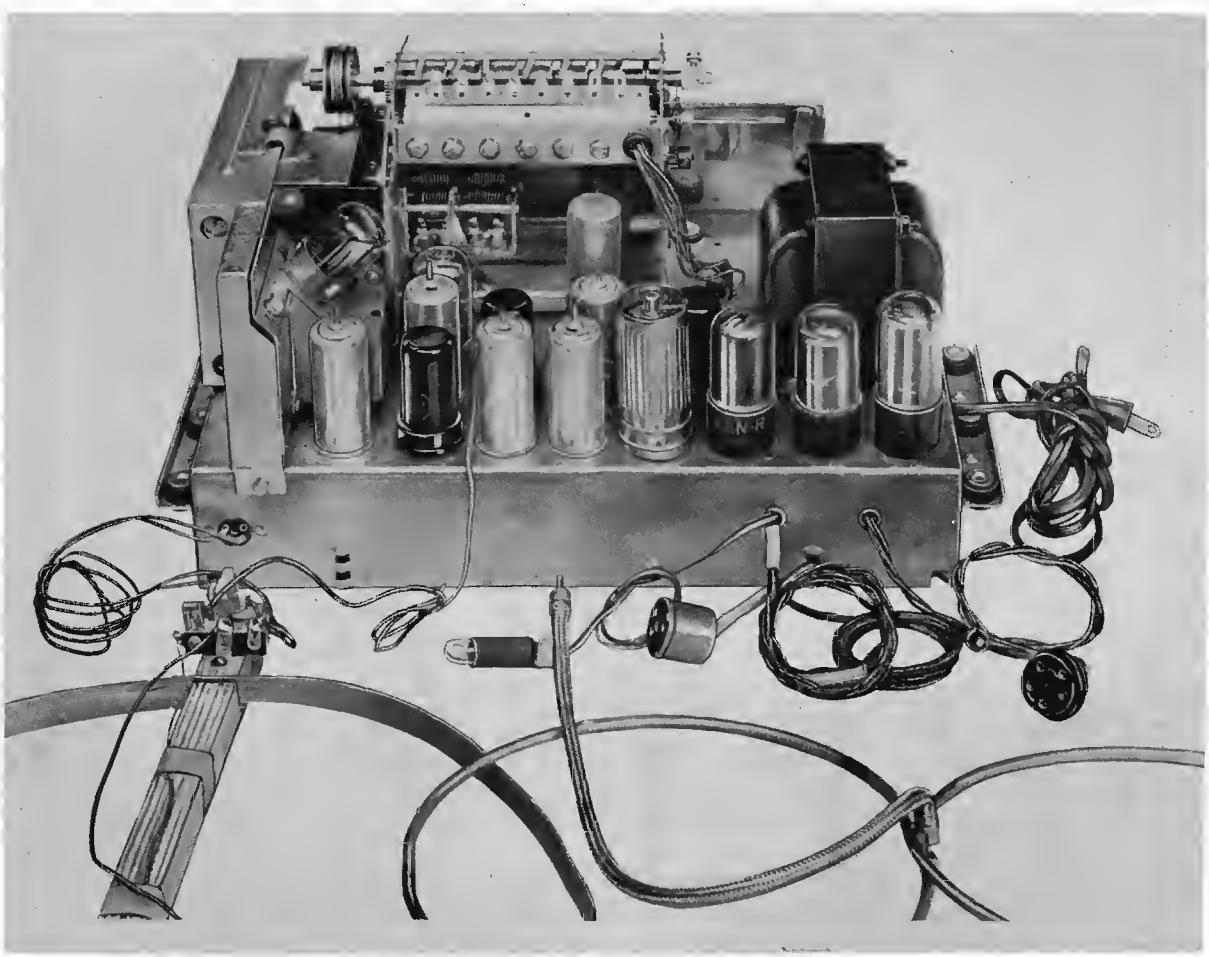


FIGURE 12. TOP VIEW OF CHASSIS

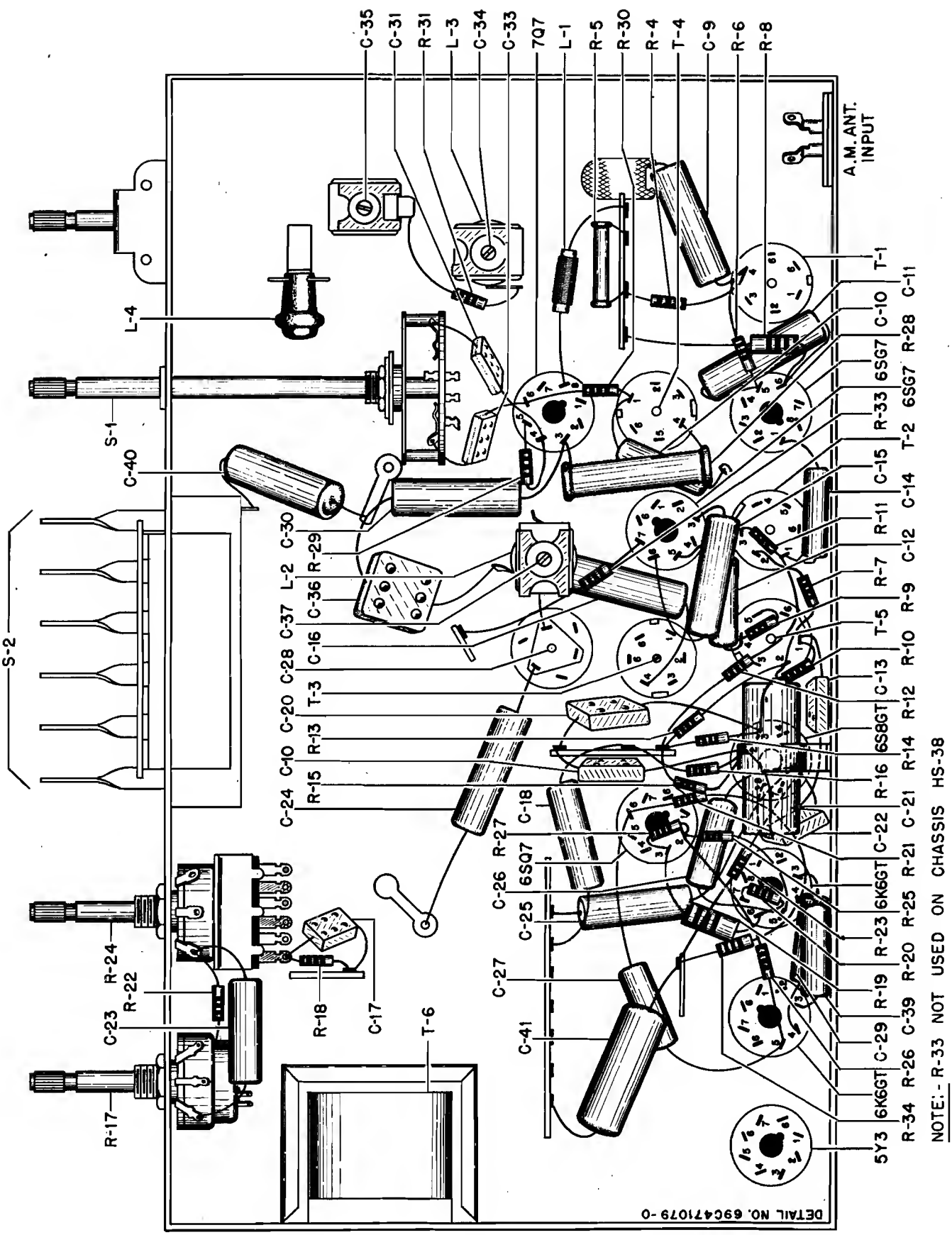


FIGURE 13. BOTTOM VIEW OF CHASSIS

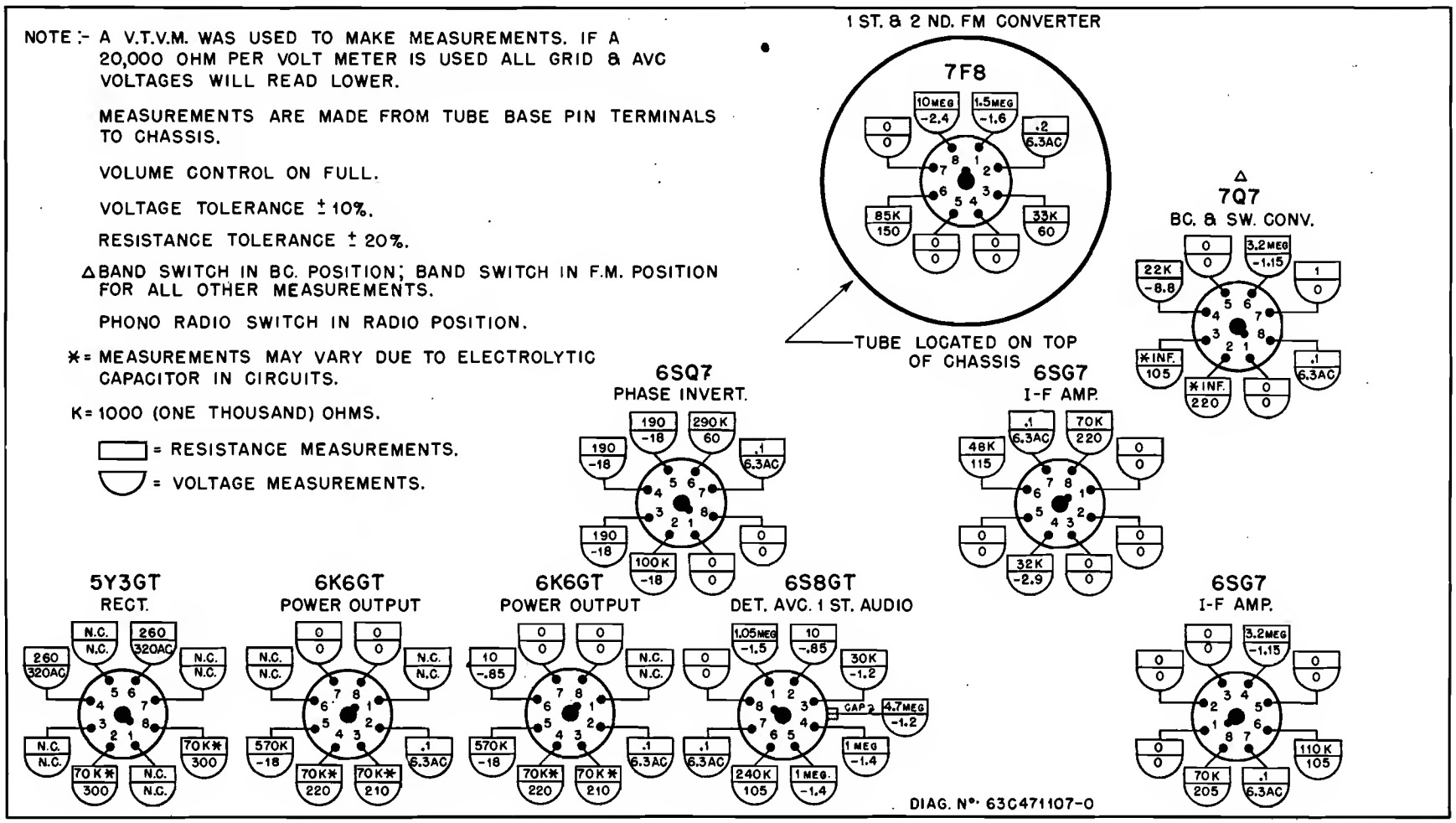


FIGURE 14. VOLTAGE AND RESISTANCE DIAGRAM

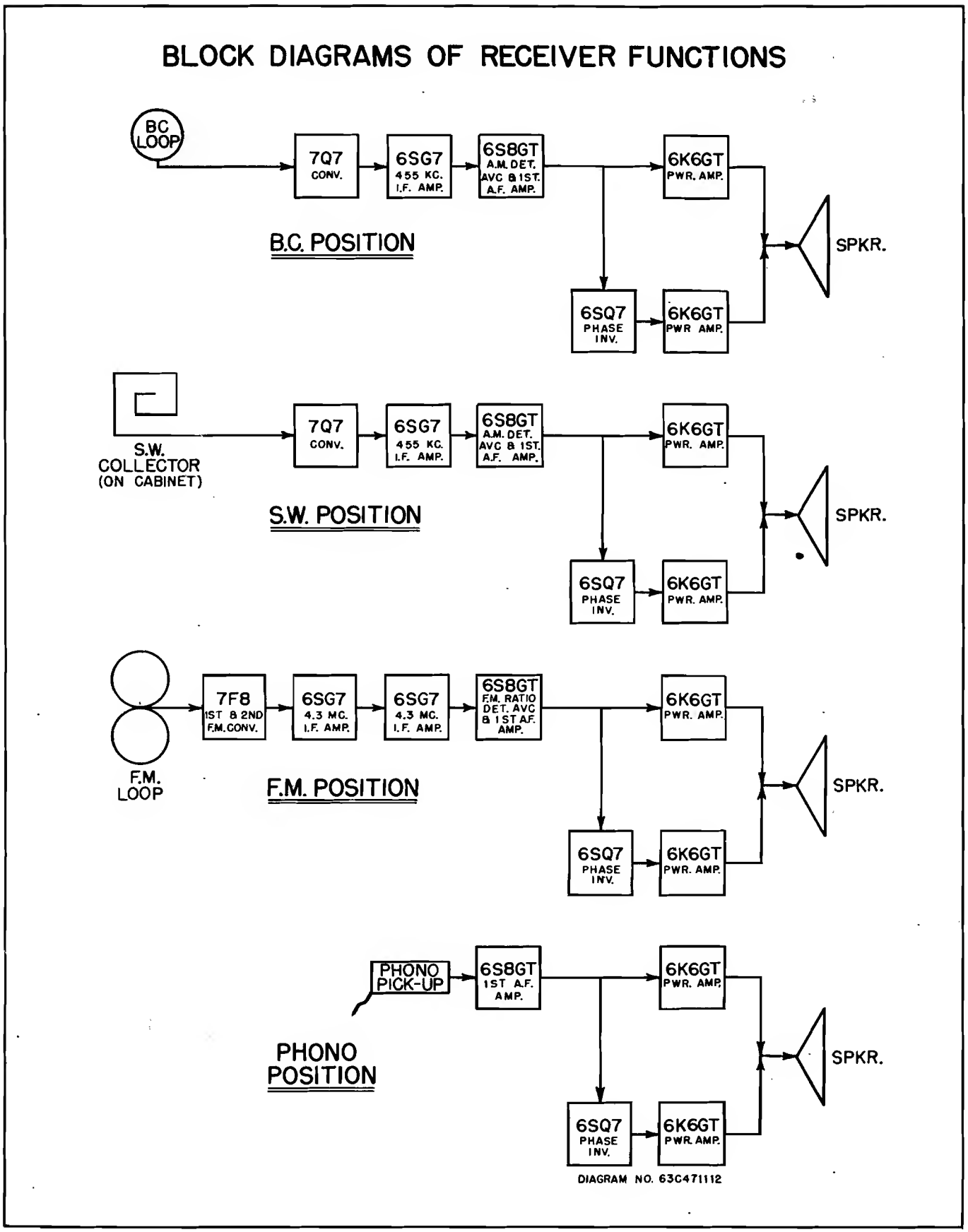


FIGURE 15. BLOCK DIAGRAMS

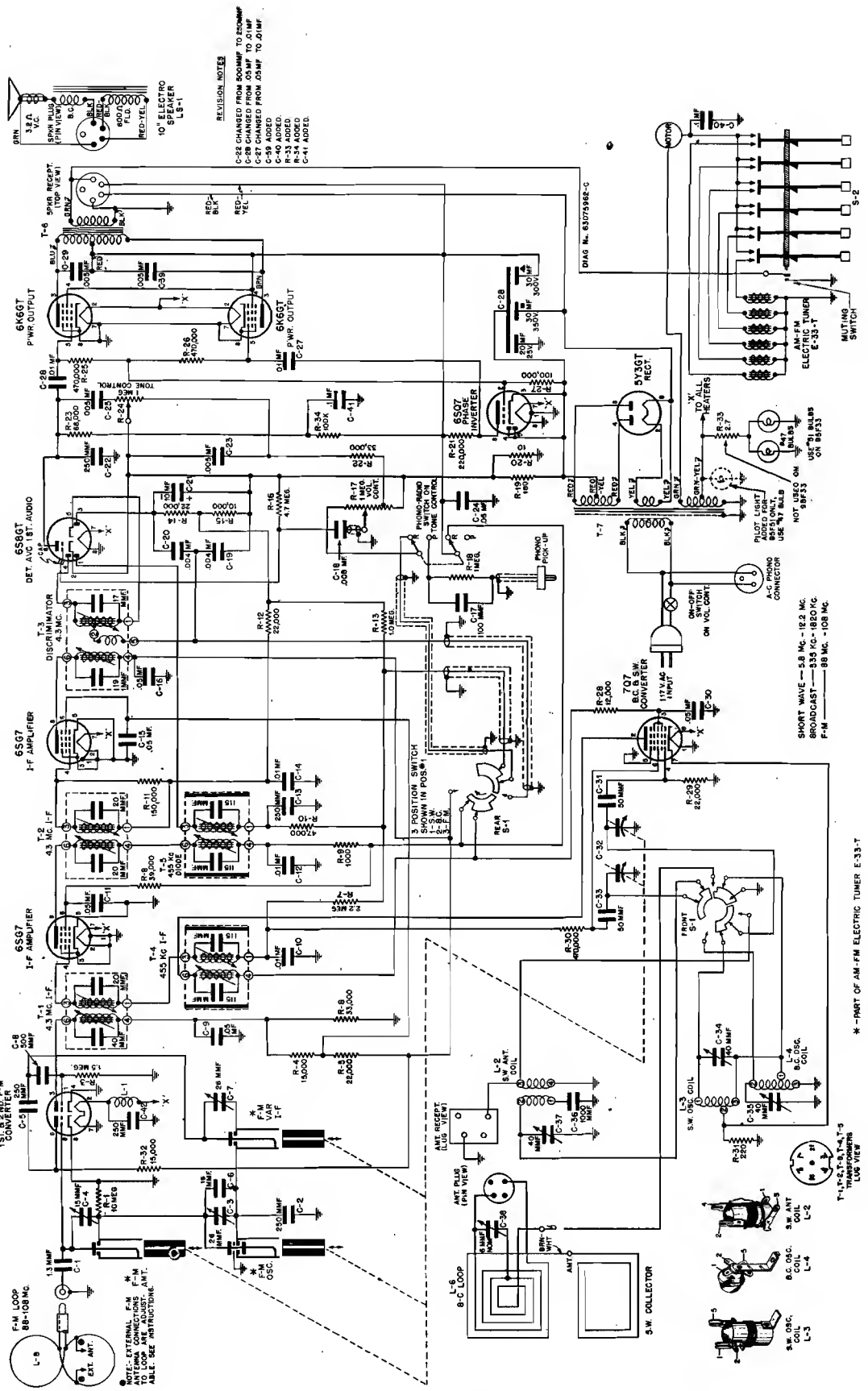


FIGURE 16. COMPLETE SCHEMATIC DIAGRAM

PARTS PRICE LIST
MODELS 95F31, 95F31B, 95F31M AND 95F33

REF. NO.	PART NO.	DESCRIPTION	LIST PRICE
CAPACITORS:			
C-1	21A75479	Special: 1.3 mmf	.15
C-2	21A112247	Silver mica: 250 mmf	.75
C-3	20K74940	Variable ceramic: 7-45 mmf	1.50
C-4	20A74939	Variable ceramic: 5-25 mmf	1.50
C-5	21R2729	Mica: 250 mmf 500V	.35
C-6	21A76320	Ceramic: 16 mmf	.20
C-7	20K74940	Variable ceramic: 7-45 mmf	1.50
C-8	21R2730	Mica: 500 mmf 500V	.45
C-9	8S9801	Paper: .05 mf 100V	.20
C-10	8S9809	Paper: .01 mf 400V	.20
C-11	8S9816	Paper: .05 mf 400V	.20
C-12	8S9809	Paper: .01 mf 400V	.20
C-13	21R6648	Mica: 250 mmf 500V	.25
C-14	8S9801	Paper: .01 mf 100V	.20
C-15	8S9816	Paper: .05 mf 400V	.20
C-16	8S9816	Paper: .05 mf 400V	.20
C-17	21R6641	Mica: 100 mmf 500V	.20
C-18	8S9813	Paper: .005 mf 600V	.20
C-19	21R6661	Mica: .004 mf 10% 300V	.70
C-20	21R6661	Mica: .004 mf 10% 300V	.70
C-21	23K77635	Electrolytic: 10 mf 100V	.95
C-22	21R6648	Mica: 250 mmf 500V	.25
C-23	8S9813	Paper: .005 mf 600V	.20
C-24	8S9816	Paper: .05 mf 400V	.20
C-25	8S9813	Paper: .005 mf 600V	.20
C-26	8S9809	Paper: .01 mf 400V	.20
C-27	8S9809	Paper: .01 mf 400V	.20
C-28	23A27718	Electrolytic: 30-30-20 mf/350-300-25V	2.70
C-29	8S9813	Paper: .005 mf 600V	.20
C-30	8S9816	Paper: .05 mf 400V	.20
C-31	21R6642	Mica: 50 mmf 500V	.20
C-32	19B72560	Variable: 2 gang	4.25
C-33	21R6642	Mica: 50 mmf 500V	.20

REF. NO.	PART NO.	DESCRIPTION		LIST PRICE
RESISTORS:				
R-1	6R2109	10 meg 1/2w	doz.	1.00
R-2				
R-3	6R6013	1.5 meg 1/2w	doz.	1.00
R-4	6R6477	15,000 10% 1/2w	doz.	1.00
R-5	6R6313	22,000 10% 1w not Ins.	each	.15
			doz.	1.45
R-6	6R6410	33,000 10% 1/2w	doz.	1.00
R-7	6R6433	2.2 meg 10% 1/2w	doz.	1.00
R-8	6R5588	39,000 10% 1w		
R-9	6R6301	1000 1/2w	doz.	1.00
R-10	6R6056	47,000 1/2w	doz.	1.00
R-11	6R6398	150,000 10% 1/2w	doz.	1.00
R-12	6R6397	22,000 10% 1/2w	doz.	1.00
R-13	6R6004	1 meg 1/2w	doz.	1.00
R-14	6R6397	22,000 10% 1/2w	doz.	1.00
R-15	6R6320	10,000 10% 1/2w	doz.	1.00
R-16	6R6446	4.7 meg 10% 1/2w	doz.	1.00
R-17	18K74891	Volume control & switch: 1 meg; tapped at 300K		1.20
R-18	6R6046	1 meg 10% 1/2w	doz.	1.00
R-19	6R3968	180 10% 2W		.20
R-20	6R5621	10 10% 1/2w	doz.	1.00
R-21	6R6015	220,000 1/2w	doz.	1.00
R-22	6R6410	33,000 10% 1/2w	doz.	1.00
R-23	6R6000	68,000 1/2w	doz.	1.00
R-24	18A28062	Tone Control & Phono-Radio Switch; 1 meg		1.20
R-25	6R6032	470,000 1/2w	doz.	1.00
R-26	6R6032	47,000 1/2w	doz.	1.00
R-27	6R6075	100,000 1/2w	doz.	1.00
R-28	6R3967	12,000 10% 3w Not Ins.		.35
R-29	6R6028	22,000 1/2w	doz.	1.00
R-30	6R6032	470,000 1/2w	doz.	1.00
R-31		220 1/2w	doz.	1.00

C-34	20A71141	Mica Trimmer: 10-80 mmf	.30
C-35	20A75234	Mica Trimmer: 10-80 mmf: with mounting bracket	.30
C-36	21R2724	Mica: 1000 mmf 5% 300V	.40
C-37	20A71141	Mica trimmer: 10-80 mmf	.30
C-38	20A71228	Mica trimmer: 2-12 mmf: with mounting bracket	.30
C-39	8S9813	Paper: .005 mf 600V	.20
C-40	8S9808	Paper: .1 mf 200V	.25
C-41	8S9807	Paper: .1 mf 400V	.25
C-42	21A112247	Silver mica: 250 mmf	.75

COILS:

L-1	24A74989	Filament choke	.35
L-2	24A74822	S. W. Antenna	1.05
L-3	24A74820	S. W. oscillater	.80
L-4	24A74821	B. C. oscillator	.85
L-5	1X78328	Loop Assembly, FM Band: with leads	3.30
	14A75142	Insulator, FM loop mtg: bakelite	.25
L-6	24C75532	Loop Assembly, BC band: complete with leads and trimmer (95F33)	4.35
	24K76103	Same as above except for (95F31, 95F31B & 95F31M)	4.35
	29K19871	Plug, 4 pin (loop plug)	.10

TRANSFORMERS:

T-1	24B75481	1st I.F.: 4.3 Mc; complete with iron cores and padding, capacitors, but less shield	2.55
T-2	24B75473	2nd I.F.: 4.3 Mc; complete with iron cores and padding capacitors but less shield	2.80
T-3	24B75456	Discriminator: 4.3 Mc; complete with iron cores and padding capacitors but less shield.	3.85
	26B70107	Shield, coil (for T-1, T-2, & T-3)	.20
T-4	24B75487	I.F.: 455 Kc; complete with iron cores and padding capacitors but less shield	2.60
T-5	24B70537	Diode: 455 Kc; complete with iron cores and padding capacitors but less shield	2.45
	1A71049	Shield & Iron Core Sleeve Assembly (for T-4 & T-5)	.30
T-8	25K74706	Output	3.50
T-7	25C75489	Power	10.65

R-32	6R8013	15,000 1w Not Ins.		
R-33	17K77834	Wire wound: 2.7 1/2w		.75
R-34	6R6075	100,000-1/2w	doz.	1.00

SWITCHES:

S-1	40B74864	Switch, band: 3 position	2.00
S-2	1X75820	Switch, push button: 6 button; with muting switch	2.10

SPEAKER:

	50B72379	Electrodynamic: 10"; 800 ohm field; 3.2 ohms V.C. 11.25

CHASSIS PARTS (HS-38 & HS-39)

	7A14684	Bracket, tuning shaft	.10
	65X11854	Bulb: 6-8V, bayonet base; tubular; #47	.15
	65X4151	Bulb: 6-8V, bayonet base; round; #51	.15
	11M8944	Cord, dial: 18 lb; black yard	.10
	30K21859	Cord, line: 9 ft. long; with plug	1.00
	1X76408	Dial Assembly: includes pointer rail with slider, 2 mtg. brackets, 5 cord pullies and 2 pilot light sockets (HS-38 chassis)	1.60
	1X76370	Dial Plate, Brackets & Pulleys Assembly: complete dial assembly, but less pointer, glass dial scale and dial scale rubber channel strips (HS-39 chassis)	1.50
	1X76402	Lead Assembly, phono pick up; with 1 pin plug; 42" long	.35
	1X76366	Lead Assembly, speaker: includes receptacle	.85
	32A24815	Lock, line cord: fibre doz.	.25
	9A12705	Plate, electrolytic capacitor mtg: bakelite doz.	.30
	28K71775	Plug, 1 pin (phono pick-up)	.10
	52B71280	Pointer, dial (HS-38)	.20
	52B74418	Pointer, dial (HS-39)	.25
	1X76393	Pulley Assembly: two 1-5/16" pulleys on brass bushing (tuner shaft)	.45
	49A23960	Pulley, cord: 1/4 groove (cord guide) doz.	.30
	49A21552	Pulley, cord: 1/2 groove (cord guide) doz.	.30

REF. NO.	PART NO.	DESCRIPTION	LIST PRICE
	49A21741	Pulley, cord: 3/8 groove (cord guide) doz.	.30
	9A30680	Receptacle, 3 prong (on phono power cord)	.15
	9K28049	Receptacle, 4 prong (loop receptacle)	.10
	34C77423	Scale, dial: glass (HS-39 chassis)	1.00
	1X76352	Shaft Assembly, tuning	.25
	26A26283	Shield, tube	.05
	9A74416	Socket, pilot light (HS-38 chassis)	.25
	9A72747	Socket, pilot light (HS-39 chassis)	.25
	60K75432	Socket, pilot light: with clip & leads (HS-39-on cabinet)	.40
	9A6788	Socket, tube: molded octal; plain type	.20
	9A70165	Socket, tube: molded octal; shielded type	.35
	9A72519	Socket, tube: molded loctal	.20
	41A21332	Spring, tension coil (string drive) doz.	.50
	37K21114	Strip, channel: rubber; 1" long (dial scale mtg. on chassis HS-39) doz.	.15
	32A27678	Strip, shaft bearing: fibre (for band sw.) doz.	.30
	31A14424	Strip, terminal: 1 insulated lug, #2 mtg. doz.	.35
	31A15433	Strip, terminal: 1 large insulated lug, #2 mtg. doz.	.35
	31A14655	Strip, terminal: 3 insulated lugs, #3 mtg. doz.	.80
	31A75232	Strip, terminal: 4 insulated lugs, #3 mtg. doz.	.90
	31A75233	Strip, terminal: 7 insulated lugs, #1 & 9 mtg.	.15
	39A24524	Wiper, tube base grounding doz.	.20

MISC. CHASSIS HARDWARE:

	42A5480	Clip, grid: small doz.	.15
	4S7655	Lockwasher: 3/8 internal; cadmium plated (band switch mounting) per/c	.50
	2S7018	Nut: 3/8-32 x 1/2 hex; cadium plated (band switch mtg.) per/c	.50
	2S7051	Nut: 3/8-32 x 9/16; hex palnut; cadmium plated (volume & tone control mtg.) doz.	.15
	5A12814	Rivet, shoulder: 5/32 long (cord pulley mtg.) doz.	.15
	5K74560	Rivet, shoulder: 5/16 long (cord pulley mtg.) per/c	.50
	5A71246	Rivet, shoulder; 3/16 long (cord pulley mtg.) doz.	.15
	3S7506	Screw: #6 x 1/4 PKZ plain hex head sheet metal screw; cadmium plated (coil mtg.) per/c	.50
	3S7454	Screw: #8 x 1/4 PKZ plain hex head sheet metal screw; cadmium plated (general mtg.) per/c	.50
	3S7467	Screw: #8 x 3/8 PKZ plain hex head sheet metal screw (trans. mtg.) doz.	.15
	3S7481	Screw: #8 x 3/4 PKZ slotted hex head sheet metal screw: cadmium plated (tuner mtg.) doz.	.15

Prices subject to change without notice

MODEL E-33-T AM-FM TUNER

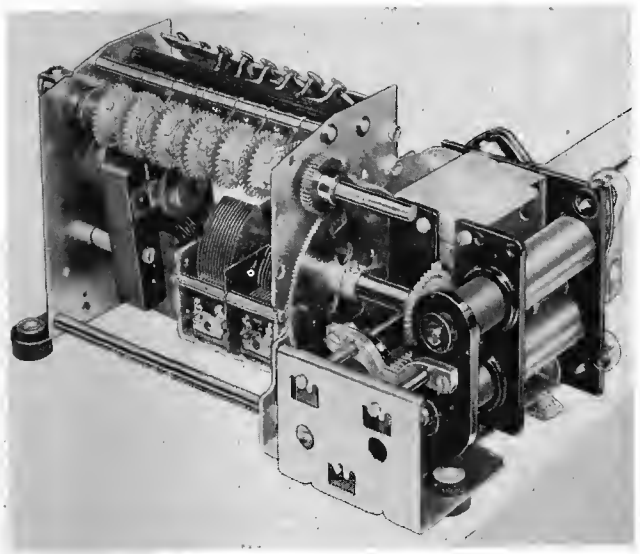


FIGURE 17. MODEL E-33-T FM-AM TUNER

Figure 17 shows the complete AM-FM Tuner E-33-T.

THEORY OF THE FM TUNER

Referring to the functional schematic diagram in Fig. 18, the triode T1 serves both as an oscillator and first converter, and triode T2 serves as the second converter. Oscillator voltage injection for the second converter is obtained through the coupling capacitor from the plate of T_1. T_1 and T_2 are sections of the 7F8 twin-triode tube.

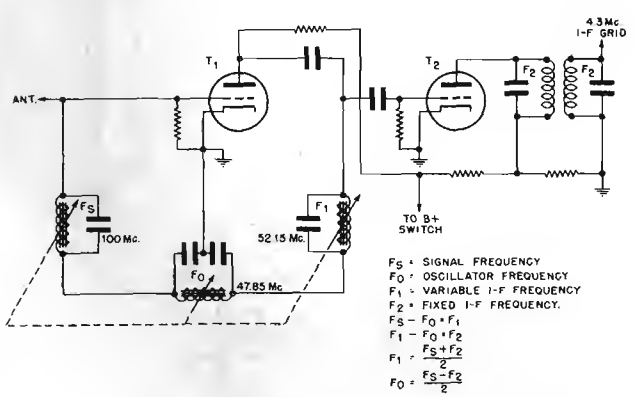


FIGURE 18. FUNCTIONAL SCHEMATIC DIAGRAM OF FM TUNER

The frequency relationships are given in Fig. 18. The oscillator F_0 beats with the incoming signal F_s to produce the first intermediate frequency F_1, which is variable. F_1 then beats with the same oscillator frequency F_0 in the second converter to produce the second intermediate frequency F_2 which is 4.3 mc. With a 100 mc signal the oscillator frequency is 47.85 mc and the variable intermediate frequency is 52.15 mc.

This system of reception permits the oscillator to be resonated with a high capacitance, 250 micromicrofarads in this case. Consequently, changes in the tube characteristics during warm-up do not produce objectionable changes in oscillator frequency. This contributes materially to the stability of the system.

The actual FM tuner schematic is shown in Figure 19.

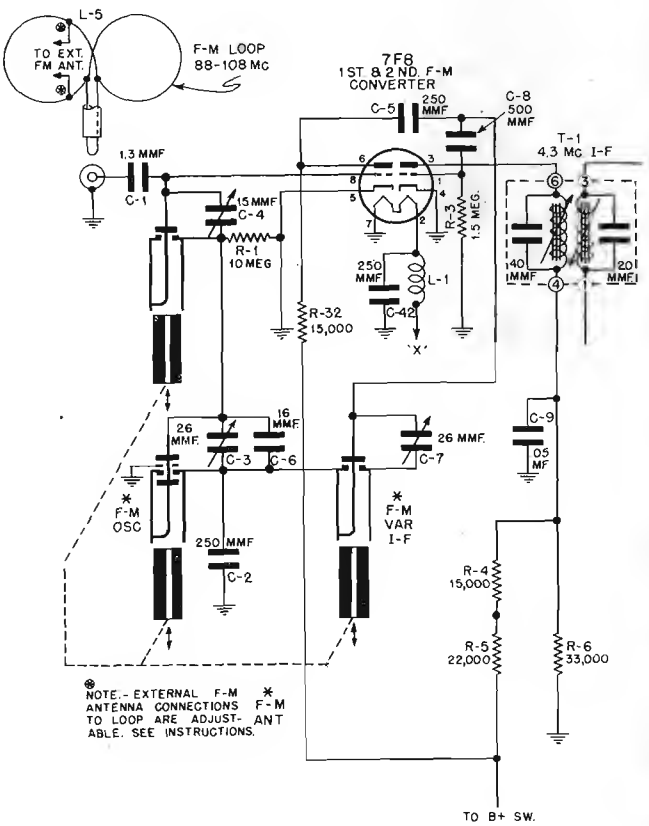


FIGURE 19. SCHEMATIC DIAGRAM OF COMPLETE FM TUNER

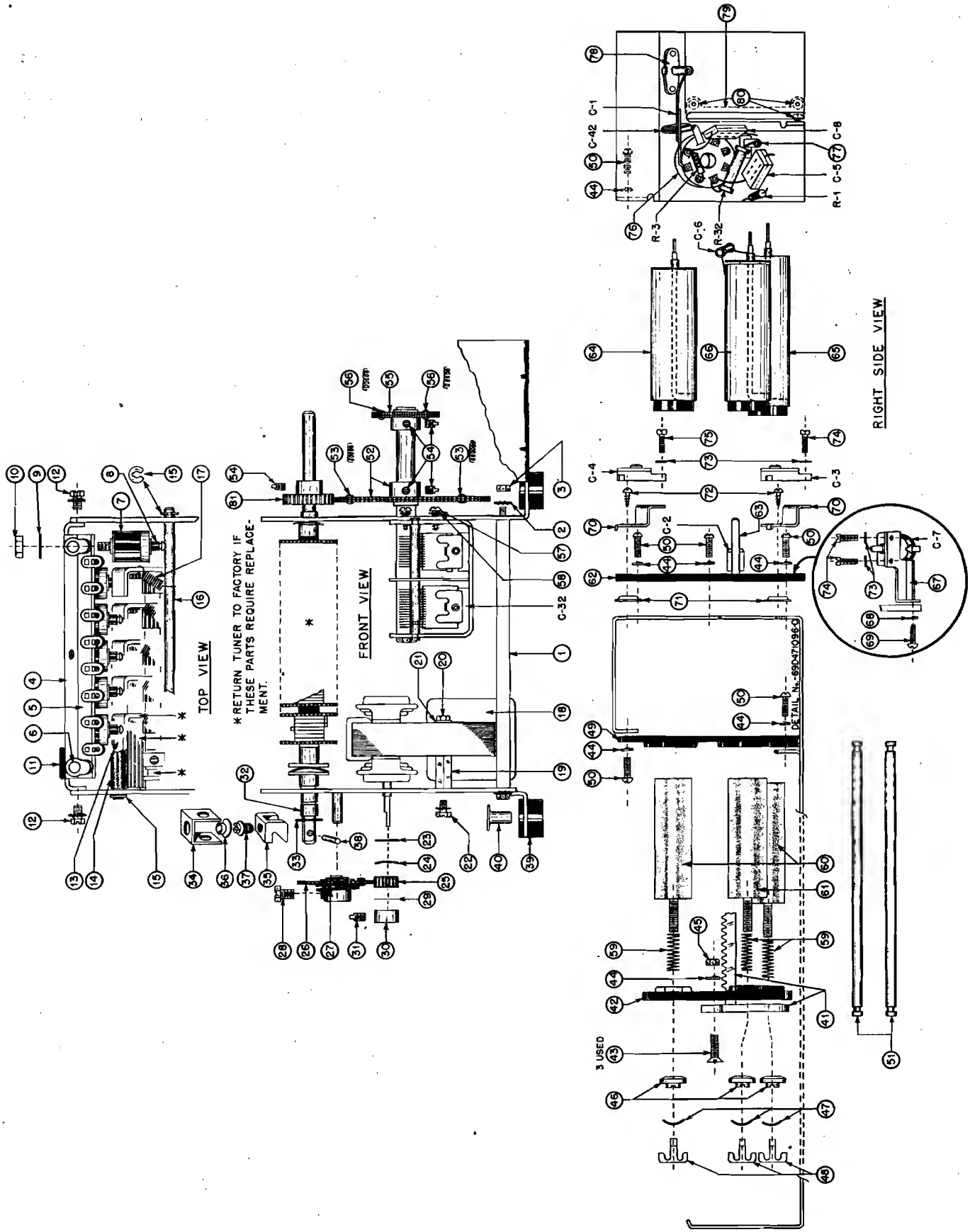


FIGURE 20. MODEL E-33-T FM-AM TUNER PARTS LOCATION

PARTS PRICE LIST
MODEL E-33-T AM-FM TUNER

REF. NO.	PART NO.	DESCRIPTION		LIST PRICE
CAPACITORS:				
C-1	21A75479	Special: 1.3 mmf.		.15
C-2	21A112247	Silver mica: 250 mmf.		.75
C-3	20K74940	Variable ceramic: 7-45 mmf.		1.50
C-4	20A74939	Variable ceramic: 5-25 mmf.		1.50
C-5	21R2729	Mica: 250 mmf 500V		.35
C-6	21A76320	Ceramic: 16 mmf.		.20
C-7	20K74940	Variable ceramic: 7-45 mmf.		1.50
C-8	21R2730	Mica: 500 mmf 500V		.45
C-32	19B72560	Variable; 2 gang		4.25
C-42	21A112247	Silver mica: 250 mmf.		.75
RESISTORS:				
R-1	6R2109	10 meg 1/2w Ins.	doz.	1.00
R-3	6R3966	1.5 meg 1/2w Ins.	doz.	1.00
R-32	6R6013	15,000 1w N.I.	each	.15
			doz.	1.45
1	45A21419	Rod, tie: threaded	doz.	.35
2	4S7651	Lockwasher: #8 internal	per/c	.50
3	2S7007	Nut: 8-32 x 1/4 hex.	per/c	.50
4	1X76383	Magnet Assembly: 6 electromagnets mounted on channel; with terminal strip	strip	3.50
5	31A74480	Strip, terminal: 8 insulated lugs, #1 & 10 mtg.		.20
6	5S7707	Rivet: .122 x 5/32 steel	per/c	.50
7	1K75593	Magnet Assembly: single electromagnet		.30
8	37A22059	Bumper, armature: rubber	per/c	.50
9	4S7562	Washer: 7/16 x .187 x .033 thick	per/c	.50
10	2S7009	Nut: 10-32 x 3/8 hex.	per/c	.50
11	37A22664	Grommet: for 7/16" hole	doz.	.30
12	3S7205	Lockscrew: 8-32 x 1/4 slotted hex head	doz.	.15
13	46K75519	Rod, stop	doz.	.65
14	11M9504	Sleeving: #4 black	ft.	.10
15	4A21577	Washer, "C" spring	per/c	.50
16	46A21765	Rod, stop: grooved		.15
17	41A22507	Spring, armature		.05
18	59B75421	Motor, tuner		5.80
19	2K75462	Nut: hex; .594 long; 6-32 thread (motor spacer)	doz.	.80
20	3S2927	Screws: 6-32 x 7/8 slotted hex head machine screw	doz.	.15
21	4S7650	Lockwasher: #6 internal	per/c	.50
22	3S7350	Lockscrew: 6-32 x 1/4 slotted hex head	doz.	.15
23	4A21409	Washer (clutch)	per/c	.50
24	4A21408	Washer, spring (clutch)	per/c	.50
25	44A21417	Pinion, clutch		.10
26	1X21576	Gear & Hub Assembly		.25
27	41A22471	Spring, cushion	doz.	.70
28	3S7163	Screw: 8-32 x 1/4 slotted hex head machine screw.	per/c	.50
29	14A21424	Washer, fibre: 7/16 x .130 x .010 thick	doz.	.15
30	43A21407	Bushing, clutch retaining		.10
31	3S7114	Setscrew: 8-32 x 3/8 slab head	doz.	.15
32	43K21412	Bushing, spacer	doz.	.35
33		Washer		
34	42A10982	Yoke, retainer	doz.	.25
35	42A10981	Yoke, cam		.10
36	5S7818	Eyelet: .135 x .268	per/c	.50
37	3A10990	Screw, yoke lock	doz.	.20
38	47A11004	Pin, drive shaft	doz.	.20
39	37K15125	Grommet, tuner mounting	doz.	.50
40	5A12105	Eyelet, mounting	doz.	.20
41	44B72706	Rack, drive gear: die cast		.35
42	64B72707	Plate, core mounting: bakelite		.35
43	3S7184	Screw: 6-32 x 1/2 slotted flat head machine screw	per/c	.50

REF. NO.	PART NO.	DESCRIPTION		LIST PRICE
44	4S2619	Lockwasher: #6 split	per/c	.50
45	2S7005	Nut: 6-32 x 1/4 hex	per/c	.50
46	2A72726	Nut, swivel		.05
47	4A74936	Washer, spring	doz.	.15
48	42A72725	Clip, swivel nut	doz.	.35
49	64B72704	Plate, front mounting: bakelite		.35
50	3S7185	Screw: 6-32 x 3/8 slotted round head machine screw	per/c	.50
51	47B72712	Rod, guide		.25
52	1X76389	Split Gear & Bushing Assembly (large)		.45
53	41A4547	Spring, coil	per/c	.50
54	3S7100	Setscrew: 8-32 x 5/16 slabhead	doz.	.35
55	1X76390	Split Gear & Bushing Assembly (small)		.25
56	41A76498	Spring, coil	per/c	.50
57	3S7156	Screw: 6-32 x 3/16 slotted binder head machine screw	per/c	.50
58	4S7668	Lockwasher: #6 external	per/c	.50
59	41A74680	Spring, core tension	per/c	.50
60	46A71749	Core, iron (ant. & Var.I.F.)		.90
61	46K76172	Core, iron (with paint dot) (osc.)		.90
62	1X76388	Rear Mounting Plate & Lug Assembly: bakelite plate with soldering lug		.35
63	29R3005	Lug, soldering	doz.	.15
64	24C75492	Inductor, VHF (Ant.): 2-1/2" long		.75
65	24K75494	Inductor, VHF (I.F.): 2-3/4" long		.95
66	24K75496	Inductor, VHF (Osc.): 2-5/8" long		2.80
67	7A74712	Bracket, trimmer mounting		.20
68	4S6412	Lockwasher: #4 split	per/c	.50
69	3S1937	Screw: 4-40 x 5/16 slotted round head machine screw	per/c	.50
70	7A74711	Bracket, trimmer mounting		.15
71	2A74710	Nut, Tinnerman (#4 PKZ)	doz.	.25
72	3S3356	Screw: #4 x 5/16 PKZ slotted round head sheet metal screw	per/c	.50
73	4A74864	Washer, trimmer: fibre	per/c	.50
74	3S1525	Screw: 3-48 x 3/8 slotted fillister head machine screw	per/c	.50
75	3S2975	Screw: 3-48 x 5/16 slotted fillister head machine screw	doz.	.15
76	9K75544	Socket, tube: loctal		.35
77	31A81399	Strip, terminal: 1 insulated lug; #1 mtg.	doz.	.50
78	9A54664	Receptacle, ferrule: 1 prong		.10
79	15A74714	Cover, tuner (rear)		.10
80	3S8175	Screw: #4 x 3/16 PKZ slotted hex head sheet metal screw	per/c	.50
81	44A21673	Pinion: gang drive		.50

Prices subject to change without notice